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ABRASIVE TAPE, COATING SOLUTION FOR ABRASIVE TAPE, AND MANUFACTURING OF ABRASIVE TAPE

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ABRASIVE TAPE, COATING SOLUTION FOR ABRASIVE TAPE, AND MANUFACTURING OF ABRASIVE TAPE

[*Ken'ma tehpu, kaku ken'ma tehpuyoh tokoheki narabini ken'ma tehpu no seizoh houhoh*]

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[*There are no amendments to this patent.*]

(54) [Title of the Invention]

Abrasive tape, coating solution for abrasive tape, and manufacturing of abrasive tape

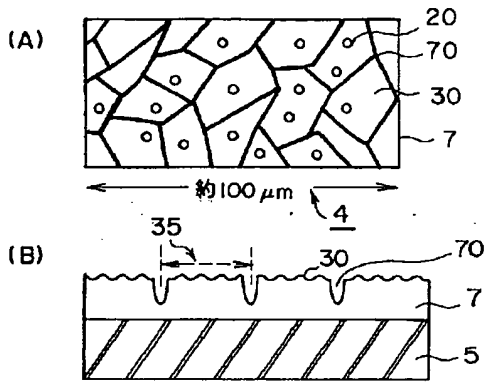
(57) [Abstract]

[Purpose]

The purpose of the present invention is to produce an abrasive tape with an absence of grinding defects produced during the grinding work, that is durable and suitable as a final finishing abrasive tape for precision parts, and a manufacturing method thereof.

[Means of solution]

Polishing layer 7 formed on one side of base material film 5 is provided with cracks 70 of a fine shape. The surface center-line mean roughness Ra of the non-crack parts 30 of polishing layer 7 is in the range of 0.001~2.0 μm, and its pitch is in the range of 1~500 μm, the grain size of silica ultra-fine particles contained in the polishing layer is in the range of 0.001~0.5 μm, and the binder of the coating solution that forms the polishing layer is a coating solution consisting of a condensate of organoalkoxysilane.



[Claims of the invention]

[Claim 1] The polishing layer formed on one side of the base material film has the features described below:

(i) The polishing layer has microscopic cracks and the center-line mean surface roughness Ra of the non-crack parts is in the range of 0.001~2.0 μm and its pitch is in the range of 1~500 μm.

(ii) The abrasive included in the polishing layer is silica ultra-fine particles of 0.001~0.5 μm.

(iii) The binder used for the polishing layer is a silicone type resin comprising an organoalkoxysilane condensate.

[Claim 2] The coating solution for the abrasive tape wherein the abrasive is an organosilica sol of the 0.001~0.5 μm particles, and the binder is a silicone type resin comprising an organoalkoxysilane

condensate, which coating solution is used for formation of the above-mentioned polishing layer.

[Claim 3] The coating solution for abrasive tape described in claim 2 wherein the weight ratio of the above-mentioned abrasive particles to the binder is in the range of 1:99~99:1, preferably, 10:90~90:10.

[Claim 4] The polishing layer formed on one side of the base material film has the features described below:

(i) The polishing layer has microscopic cracks and the center-line mean surface roughness Ra of the non-crack parts is in the range of 0.001~2.0 μm and its pitch is in the range of 1~500 μm.

(ii) The abrasive included in the polishing layer is silica ultra-fine particles of 0.001~0.5 μm.

(iii) The binder used for the polishing layer is a silicone type resin comprising an organoalkoxysilane condensate.

And a method of manufacturing the abrasive tape characterized by the fact that the non-volatile component of the coating solution for the polishing layer of the abrasive tape wherein the abrasive is an organosilica sol of 0.001~0.5 μm, and the binder is a silicone type resin comprising an organoalkoxysilane condensate, which coating solution is used for formation of the above-mentioned polishing layer, and, at the same time, the weight ratio of the above-mentioned abrasive particles and the binder is in the range of 1:99~99:1, preferably, 10:90~90:10 is adjusted to 93~37 wt%, and coating of the base film is done using the gravure reverse coating method or kiss reverse coating method to form 3~10 g/m^2 (solid parts) and immediately heated to 100• C and evaporation of the solvent is carried out; then, a curing reaction of the binder and formation of cracks are completed.

[Claim 5] The method of manufacturing the abrasive tape described in Claim 4 wherein the above-mentioned polishing layer is produced by filtration of the coating solution described above

through a 2~10 μm filter, coating the coating solution under a coating atmosphere wherein the temperature is in the range of 30~40• C and the relative humidity is 20~60%, and drying at a temperature of 100• C; then, providing a further heat treatment at a temperature of 40• C for 300 hours.

[Claim 6] The method of manufacturing an abrasive tape described in Claim 4 and Claim 5 wherein the above-mentioned polishing layer is formed on a primer layer deposited on the base film.

[Detailed description of the invention]

[0001]

[Technical field of the invention]

The present invention pertains to an abrasive tape used for finishing the surface or end face of precision parts such as optical connector ferrules, semiconductor wafers, ceramics, color filters for liquid crystal displays, plasma displays, optical glass, optical lenses, magnetic disk substrates, optical disk substrates, magnetic heads, and optical readout heads, and to the formulation of a coating solution for abrasive tapes and a method of manufacturing an abrasive tape therewith.

[0002]

[Prior art]

A multi-step polishing process is used for precision parts, for example, optical fibers and semiconductor wafers, and the quality of the product is determined by the precision of the polishing step of the mirror surface finish. And the final finishing process, referred to as mechanical polishing, where a polishing solution and polishing cloth are used in combination is used in practice. In the above-mentioned method where a polishing solution is used, the polishing process is complicated; thus, as a method to replace the above-mentioned process, a method wherein an abrasive tape is used has been proposed. The above-

mentioned abrasive tape is produced by coating a base film for the abrasive tape, mainly comprising a plastic, with a coating solution consisting of a varnish produced by dispersing abrasive particles and a binder (a material used for bonding the abrasive particles to the base film and is a structure comprising synthetic resins or natural resins, plasticizers, lubricants, antistatic agents, etc.) in an appropriate solvent suitable for coating, and drying the coating solution and curing the layer, as needed.

[0003] As abrasive particles for an abrasive tape suitable for use as an abrasive for precision parts, spherical primary particles of 0.001~0.7 μm are used. Furthermore, the smaller the particle diameter of the abrasive, the higher the ratio of the abrasive that must be included in the coating solution, and the greater the particle diameter, the lower ratio of the abrasive that must be included in the coating solution. When the particle diameter is less than 0.001 μm, an adequate polishing effect cannot be achieved; on the other hand, when the particle diameter exceeds 0.7 μm, scratches are formed in the object being polished. Thus, particles with a diameter in the range of 0.001~0.7 μm are used effectively. However, when fine particles of 0.7 μm or greater are used for the abrasive tape for precision parts where a super-fine surface finish of 10^9 units is required, polishing defects in the surface pose a problem, and for example, when polishing is done for optical connector ferrules, a significant decrease in the attenuation of the signal is observed, in some cases.

[0004]

[Problems to be solved by the invention]

With regard to the abrasive particles used for the abrasive tape, an abrasive tape wherein silica ultra-fine particles with a mean particle diameter in the range of 0.001~0.02 μm and having a flat surface are being proposed. However, an adequate polishing effect cannot be achieved in an abrasive tape where the above-mentioned silica ultra-fine particles alone are used as the abrasive particles. Furthermore, polishing chips form scratches in the surface of the object being polished with a conventional abrasive

tape, and maintenance of long-lasting polishing performance is not possible.

[0005] Based on the above-mentioned background, the purpose of the present invention is to produce an abrasive tape capable of achieving precision polishing to achieve a mirror finish for precision parts such as the end faces of optical connector ferrules and the surfaces of semiconductor wafers by using silica ultra-fine particles with a particle diameter of 0.001~0.5 μm, to provide a lower degree of attenuation of signals, and having surface cracks in the polishing layer to recover the polishing chips along with the tape and having improved wettability, and the coating solution for the abrasive tape, and to provide a method of manufacturing the above-mentioned abrasive tape.

[0006]

[Means to solve the problem]

The abrasive tape of the present invention capable of eliminating the above-mentioned existing problems exhibits the features described below. Namely,

An abrasive tape:

(i) The polishing layer has microscopic cracks and the center-line mean surface roughness Ra of the non-crack parts is in the range of 0.001~2.0 μm and its pitch is in the range of 1~500 μm.

(ii) The abrasive included in the polishing layer is silica ultra-fine particles of 0.001~0.5 μm.

(iii) The binder used for the polishing layer is a silicone type resin comprising an organoalkoxysilane condensate.

[0007] The abrasive particles included in the coating solution that structures the polishing layer of the present invention is an organosilica sol of 0.001~0.5 μm, and the binder has a structure comprising a silicone type resin comprising an organoalkoxysilane condensate. The weight ratio of the abrasive particles included in the above-mentioned coating solution (organosilica sol) and the binder is in the

range of 1:99~99:1, preferably, 10:90~90:10.

[0008] The method of manufacturing the above-mentioned polishing layer is a method consisting of adjusting the non-volatile component to 93~37 wt%, and coating an ultrasonically dispersed coating solution onto the base film using the gravure reverse coating method or kiss reverse coating method to form 3~10 g/m^2 (solid parts, hereinafter in the present specification coating ratio means parts solids) and immediately heating to 100• C to evaporate the solvent; then, curing the binder and to form a net-like structure having fine cracks. Furthermore, the method of manufacturing the above-mentioned polishing layer is a method consisting of filtration of the coating solution through a 2~10 μm filter, coating the coating solution in a coating atmosphere where the temperature is in the range of 30~40• C and the relative humidity is 20~60%, and drying at a temperature of 100• C; then, performing a further heat treatment at a temperature of 40• C for 300 hours.

[0009] Furthermore, a method of manufacturing an abrasive tape wherein the above-mentioned polishing layer is formed on a primer layer deposited on the base film.

[0010]

[Embodiment of the invention]

As shown in Fig. 1(A) and (B), polishing layer 7 deposited on one side of base film 5 of the abrasive tape 4 of the present invention has the features described below. Namely,

(i) polishing layer 7 has a net-like structure of microscopic cracks 70 such as those shown in Fig. 1, and the center-line mean surface roughness Ra of non-crack parts 30 of polishing layer 7 is in the range of 0.001~2.0 μm, and its pitch is in the range of 1~500 μm.

(ii) The silica particles of the abrasive particles included in the polishing layer comprise silica ultra-fine particles with a size in the range of 0.001~0.5 μm.

(iii) The binder for the silica ultra-fine particles is a silicone resin comprising of an organoalkoxysilane

condensate with a mean molecular weight in the range of 300 to 2000, preferably 500 to 1500, and a mean polymerization degree in the range of 20 to 200, preferably in a range of 50 to 150.

[0011] Furthermore, the abrasive particles of the coating solution that comprises the polishing layer of the present invention is an organosilica sol in the range of 0.001~0.5 μm, and the binder is a silicone type resin comprising an organoalkoxysilane condensate having a mean molecular weight in the range of 300~2000. Furthermore, the weight ratio (solids ratio) of the (organosilica sol) to (binder) of the abrasive of the above-mentioned coating solution is in the range of 1:99~99:1.

[0012] The manufacturing method of the above-mentioned polishing layer is a method consisting of adjusting the non-volatile component to 93~37 wt%, and coating the ultrasonically dispersed coating solution onto the base film using the gravure reverse coating method or kiss reverse coating method to form 3~10 g/m^2 and immediately heating to 100• C to evaporate the solvent; then, curing the reaction of the binder and to form a net-like structure of fine cracks in the coated film. Furthermore, the method of manufacturing the above-mentioned polishing layer is a method consisting of filtration of the coating solution through a 2~10 μm filter, coating the coating solution under a coating atmosphere where the temperature is in the range of 30~40• C and the relative humidity is 20~60%, and drying at a temperature of 100• C; then, providing a further heat treatment at a temperature of 40• C for 300 hours to correct distortion of the polishing layer having cracks at the time of the coating and drying process.

[0013] In this case, polishing layer 7 can be formed directly on base film 5 made of plastic film such as polyester with a thickness in the range of 50~100 μm shown in Fig. 1(B). It is further desirable when the polishing layer is formed after depositing a primer layer 6 on the base film so as to further stabilize adhesion between the polishing layer and base film as shown in Fig. 3.

[0014] The base film used for the abrasive tape of the present invention can be selected from among films having an adequate strength for polishing work, adequate strength, and heat-resistance for coating

and drying of the abrasive, and a lower degree of change in dimensions after laminating with the protective film. For example, drawn or non-drawn films made of polyolefin type resins such as high-density polyethylene and polypropylene, polystyrene, polyvinyl chloride, polyvinylidene chloride, polyvinyl alcohol, ethylene-vinyl alcohol copolymer, polyacrylonitrile, polyamide, acrylic resins mainly comprising acrylate or methacrylate, polyesters such as polyethylene terephthalate, polybutylene terephthalate, and polyethylene naphthalate, polyacetal, dicellulose acetate, tricellulose acetate, polycarbonate, etc. can be mentioned.

[0015] It is desirable when an antistatic agent is added to the base film to prevent adsorption of dust. The antistatic agent used in this case can be selected from among the groups of standard nonionic surfactants, anionic surfactants, cationic surfactants, polyamide derivatives, and acrylic acid derivatives.

[0016] In this case, a biaxially drawn polyethylene terephthalate, nylon 6, polyimide, etc. having a thickness in the range of 25~200 μm having excellent coating properties and handling ease during the course of the post treatment and polishing process can be used. Furthermore, it is desirable when a treatment for increasing the adhesion such as corona treatment or ozone treatment is applied to the side [of the base film] where the primer layer and the polishing layer are to be deposited. A desirable base film is a polyester where many different types are available and modification can be done easily, and in particular, a film of 25~200 μm made of a biaxially drawn polyethylene terephthalate having high heat-resistance and rigidity and having a different polyester for the primer layer is desirable.

[0017] The primer layer used for the polishing layer of the present invention varies depending on the type of base film used, and the primer layer is produced by coating a varnish mainly comprising vinyl chloride-vinyl acetate base copolymer, polyvinyl acetal base resin, acrylic base resins such as alkyl polyacrylate and alkyl polymethacrylate or copolymers thereof, ethylene base copolymers, rubber base derivatives, polyester base resins, polyamide base resins, phenol base resins, epoxy base resins,

aminoplast resins, polyurethane resins, and cellulose derivatives onto a non-drawn film or uniaxially drawn film, and biaxial drawing so as to further increase the adhesive strength between the base film and primer layer or simply coating onto a drawn film.

[0018] For the primer layer deposited to increase the adhesive stability between the polishing layer and base film, blocking of the primer layer can be prevented when coating is done at the time of coating the polishing layer; thus, in addition to the above-mentioned varnishes made of the material used for the above-mentioned binder, materials having good affinity with the base film and a low glass transition point and having high adhesion can be used as well. And, depending on the type of varnish used, when a curing agent such as an isocyanate is added, adhesion between the base film and polishing layer can be increased.

[0019] After depositing the primer layer onto a non-drawn or uniaxially drawn film, and when drawing is done, the primer layer is thermally fused with the film, and adhesion between the base film and primer layer can be increased. Furthermore, formation of the primer layer can be achieved by coextrusion with the film. For example, when coextrusion of a resin having a different (lower) crystallization temperature that the resin that comprises the base film and the resin used for the primer layer, such as polyethylene terephthalate and linear polyester (a polyester having the secondary transition point Tg in the range of 40~130• C, for example) or polypropylene and an ethylene-vinyl acetate copolymer, and drawing is performed, a base film having stable adhesion with the polishing layer and having a uniform thickness can be produced.

[0020] The particles that comprising the abrasive used for the polishing layer of the present invention is an organosilica sol having ultra-fine particles with a mean particle diameter in the range of 0.001~0.5 μm. In general, the abrasive particles used for an abrasive tape suitable for precision parts has spherical primary particles with 0.01~0.7 μm. And the smaller the diameter of the abrasive particles, the greater

the ratio mixed in the coating solution, and the larger the particle diameter, the smaller the ratio mixed. Furthermore, when the particle diameter is below 0.01 μm the polishing effect achieved is insignificant; on the other hand, when the particle diameter exceeds 0.7 μm, scratches are formed in the object being polished, in some cases. Thus, particles in the range of 0.01~0.7 μm can be used effectively. However, for the abrasive tape used for precision parts wherein a finer surface finish is required, use of a fine particles in the range of 0.001~0.002 μm is proposed. In general, the polishing performance is not adequate when the above-mentioned ultra-fine particles are used. In the present invention, the synergistic effect of the cracks formed in the binder of the polishing layer is utilized and an abrasive tape for finishing of the precision parts is produced.

[0021] In order to uniformly disperse the ultra-fine particles with a mean particle diameter in the range of 0.001~0.5 μm with a viscous varnish, for example, a method wherein wetting of the silica ultra-fine particles with a solvent such as isopropyl alcohol, a method wherein mixing is performed for the silica ultra-fine particles with a solvent containing a nonionic surfactant or anionic surfactant so as to produce a coating solution and uniformly dispersing the above-mentioned ultra-fine particles in the coating solution is carried out. It is further desirable when a solvent is added a small amount at a time to abrasive particles to thoroughly disperse them in the solvent and a uniform dispersion is produced; then, thorough mixing is provided as the binder dissolved in a solvent is added, a small amount at a time; then, production of a well-dispersed coating solution is produced using ultrasonic waves. Filtration is provided for the coating solution through a filter of 2~10 μm, and removal of secondary aggregates of the abrasive particles is done using a method such as precipitation, and the resulting solution is used for coating.

[0022] In order to harden the binder in the polishing layer, it is desirable when production of the coating solution is done by adding zinc, manganese, zirconium, lanthanum, cobalt, tin or other organic metal

compounds (organic acid salts), or an alkyl titanate compound.

[0023] For the binder of the present invention, organic and inorganic composite resins, prepolymers, oligomers, and polymers having a siloxane bond [siloxane bond: (-Si-O-)n] in the structure can be used. It is then used as a polysiloxane derivatives thereof, modified materials thereof, or blend materials thereof.

[0024] In specific terms, mixing or reaction is performed for a monomer, prepolymer, oligomer or polymer that structures polysiloxane and a monomer, prepolymer, oligomer or polymer such as acrylic resin, polyethylene resin, polyvinyl chloride resin, polyvinyl acetate resin, polyvinyl alcohol resin, polyvinyl acetal resin, rubbery polymers, polyester resin, polyamide resin, phenol resin, aminoplast, epoxy resin, polyurethane resin, and cellulose derivatives and the blend material or reaction material is used. And the amount of the optional curing agent added is in a range of 0.0001~3.5 parts by weight for 100 parts by weight of the reactive resin included in the binder in terms of the metal of the above-mentioned organic metal compound.

[0025] It is especially desirable when a prepolymer, oligomer or polymer such as polyethylene resin, polyvinyl chloride resin, polyvinyl acetate resin, acrylic resin, polyurethane resin, and polyester resin is used as a principle chain and a prepolymer, oligomer or polymer of polysiloxane is grafted as a side chain so as to provide a structure consisting of an organic compound as the principle chain and the side chain is a polymer having a siloxane bond, a prepolymer thereof, or oligomer thereof. When the above-mentioned silicone based polymer with a mean molecular weight in the range of 300~2000, preferably, in the range of 500~1500 is used for the binder of the polishing layer, partial coagulation does not take place inside the coating solution or the polishing layer, and a uniform coating can be achieved. As a result, fine cracks, which is the feature of the present invention, can be formed, and an abrasive tape suitable for super-fine polishing of ultra-precision parts can be produced. In this case, anionic, cationic,

amphoteric, or nonionic surfactants can be used as a dispersant.

[0026] The weight ratio of the silica ultra-fine particles and binder in the coating solution is in a range of 1:99~99:1, preferably in a range of 10:90~90:10. When the ratio of the particle exceeds 99 wt%, the particles are likely to become detached and when the ratio is less than 1 wt%, an adequate polishing effect cannot be achieved.

[0027] As shown in Fig. 3, primer layer 6 mainly comprising epoxy resin, acrylic resin or polyester resin is formed on one side of the polyethylene terephthalate film (base film) with a thickness of 10~200 μm, preferably, 50~100 μm. Furthermore, a film treated for an improved adhesion by means of a primer layer or corona discharge treatment at the time of production of the base film can be used as well.

[0028] Subsequently, using the gravure reverse coating method where the coating ratio can be uniformly stabilized by means of a doctor blade, coating of the polishing layer is carried out at a ratio of 3~10 g/m^2, preferably 5~8 g/m^2, then, drying and solidification are performed to form cracks. In the binder of the present invention containing siloxane bonds, the curing reaction is promoted by heat and humidity. Thus, it is desirable when the atmosphere used is a high temperature, high humidity atmosphere. However, when too the temperature and humidity used are high, curing of the coating solution occurs on the gravure plate or curing of the coated polishing layer becomes irregular, or the coating solution before coating undergoes a condensation reaction and formation of gel-like material results. Therefore, a temperature in the range of 30~40• C and a relative humidity at said temperature in the range of 30~80% is suitable. Furthermore, when a heat treatment is performed at a temperature of 40~60• C that corresponds to a heat treatment at 40• C for 300 hours for the purpose of completion of the reaction, distortion of the polishing layer generated at the time of formation of cracks is corrected and a polishing layer with stable adhesion of abrasive particles can be produced.

[0029] The abrasive tape produced as explained above has a center-line mean surface roughness Ra in

the range of 0.001~2.0 μm, and has a mesh-structure with a pitch of the cracks in the range of 1~500 μm, and can be used effectively for polishing precision parts. In this manner, an abrasive tape suitable for polishing precision parts that exhibits high polishing effect and durability and with an absence of polishing flaws produced on the object being polished can be produced.

[0030] As shown in Fig. 4, the above-mentioned abrasive tape (4) of the present invention is attached to support 9 via a rotating metal plate and elastomer 8. Polishing is done with abrasive tape 4, for example, for the end face of an optical connector ferrule upon removal of coating member 3 of the optical fiber the end is polished for approximately 30~60 seconds at a rotational speed of 60 rpms. The abrasive tape of the present invention having a coating of silica ultra-fine particles and fine cracks is capable of effective polishing without causing polishing flaws in the object being polished.

[0031] In the following, the present invention is explained in further detail with application examples.

[Application Examples]

Application Examples 1~6

Ultrasonic dispersing was carried out for a silicone resin varnish of the organoalkoxysilane condensates listed in Table I below and an abrasive fine particles (organosilica sol) soaked in isopropyl alcohol; then, filtration was performed through a 3 μm filter to produce coating solutions for abrasive tapes. Subsequently, coating was performed for a primer-treated Melinex 542 (base film 5, polyethylene terephthalate film, product of ICI Japan Co., Ltd.) with a thickness of 75 μm using the above-mentioned coating solutions by means of the gravure reverse coating method with a plate (slanted line intaglio printing plate, 95 lines/25 mm, engraved depth of 80 μm) at a rate of 7 g/m^2, and drying was done at a temperature of 100• C and production of abrasive tape 4 having polishing layer 7 was carried out. Subsequently, heating was performed for the above-mentioned tape at a temperature of 50• C for 170 hours to complete the reaction.

[0032]

[Table I]

	Silicone resin base varnish		Abrasive	
Application Example 1	KR-9218*1	5 parts by weight	IPA-ST	100 parts by weight
Application Example 2	KR-213	"[1]	IPA-ST	"
Application Example 3	KR-211	"	IPA-ST	"
Application Example 4	KR-212	"	IPA-ST	"
Application Example 5	*1/*2=4/1	"	IPA-ST	"
Application Example 6	*1/*3=4/1	"	IPA-ST	"

[0033] Resin varnishes listed in Table I have the features shown below.

KR-9218 (Silicone base resin varnish)

Product of Shinetsu Chemical Ind., Ltd.

Methoxy group content 15%, solid parts 100%

KR-213 (Silicone base resin varnish)

Product of Shinetsu Chemical Ind., Ltd.

Methoxy group content 20%, solid parts 100%

KR-211 (Silicone base resin varnish)

Product of Shinetsu Chemical Ind., Ltd.

Hydroxyl group content 4%, solid parts 70%

KR-212 (Silicone base resin varnish)

Product of Shinetsu Chemical Ind., Ltd.

Hydroxyl group content 5%, solid parts 70%

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[1] Translator's note: a strange, unknown symbol is used in the table without explanation. We assume it is equal to " [the same as above].

IPA-ST (Organosilica sol dispersed in isopropyl alcohol)

Mean particle diameter 0.001~0.15 μm

Product of Nissan Chemical Ind., Ltd., solid parts 30%

[0034] Comparative Example 1

Production of a coating solution for an abrasive tape for Comparative Example 1 was accomplished with the composition shown below

Ceramic-coated material, Graska HPC 7502 30 parts by weight

(Organic and inorganic silicone composite resin solution)

Product of Japan Synthetic Rubber Co., Ltd.

Solid parts 30%

Organosilica sol 70 parts by weight

Mean particle diameter 0.10~0.15, solid parts 30%

Isopropyl alcohol dispersed, Product of Nissan Chemical Ind., Ltd.,

[0035] Comparative Example 2

Production of a coating solution for abrasive tape with the composition shown below was performed for Comparative Example 2.

Ceramic-coated material, Graska HPC 7502 30 parts by weight

(Organic and inorganic silicone composite resin solution)

Product of Japan Synthetic Rubber Co., Ltd.

Solid parts 30%

Organosilica sol 70 parts by weight

Mean particle diameter 0.10~0.15, solid parts 30%

Isopropyl alcohol dispersed, Product of Nissan Chemical Ind., Ltd.,

HPC 404H 5 parts by weight

[0036] Comparative Example 3

Production of a coating solution for abrasive tape for Comparative Example 3 was accomplished with the composition shown below

Ceramic-coated material, Graska HPC 7502 30 parts by weight

(Organic and inorganic silicone composite resin solution)

Product of Japan Synthetic Rubber Co., Ltd.

Solid parts 30%

Organosilica sol 70 parts by weight

Mean particle diameter 0.10~0.15, solid parts 30%

Isopropyl alcohol dispersed, Product of Nissan Chemical Ind., Ltd.,

Carbo acid dispersant 5 parts by weight

Product of Japan Synthetic Rubber Co., Ltd.

[0037] Precision filtration treatment was performed for the abrasive tape coating solutions produced in the above-mentioned Comparative Examples 1~3 through a 5 μm filter, coating was done on the Melinex 542 used in Application Examples with the above-mentioned coating solutions using a plate (slanted line intaglio printing plate, 95 lines/25 mm, engraved depth of 80 μm) by means of the gravure reverse coating method at a rate of 7 g/m^2, and drying was done at a temperature of 100• C and production of an abrasive tape having polishing layer 7 was achieved.

[0038] According to the standard polishing process, the adhesive on the end face of an optical connector ferrule polishing object was done with a polishing sheet made of silicon carbide to form a

spherical surface, and crude polishing was done with a diamond sheet. Subsequently, samples produced in the above-mentioned Application Examples and Comparative Examples were arranged on the polisher via an elastomer as shown in Fig. 4, and polishing of the end face 11 of the optical connector ferrule polishing object 2 was done for 30 seconds at a rotation speed of 60 rpm and the items shown below were evaluated and the results obtained are shown in Table II.

[0039] **[Table II]** Evaluation results for Application Examples and Comparative Examples

Sample	Surface characteristics		Polishing result				
	Surface roughness µm	Pitch µm	Scratches	Adhesion	Return loss	Cracks at boundary	Durability
Application Example 1	0.17	20	•	•	Very good	•	•
Application Example 2	0.18	10	•	•	Very good	•	•
Application Example 3	0.17	10	•	•	Very good	•	•
Application Example 4	0.16	15	•	•	Very good	•	•
Application Example 5	0.15	20	•	•	Very good	•	•
Application Example 6	0.16	20	•	•	Very good	•	•
Comparative Example 1	0.04	*Not observed	•	•	Very good	x	Δ
Comparative Example 2	0.04	*Not observed	•	•	Very good	x	Δ
Comparative Example 3	0.05	*Not observed	•	•	Very good	x	Δ

*** Not observed: Formation of cracks are not observed.**

Evaluation standard

• /double circle/ : Very good

• /circle/ : Good

Δ /triangle/ : inadequate but applicable

[0040] When finishing of the end face 11 of the optical connector ferrule of optical fiber 2 shown in Fig.

4 was carried out with each sample produced in the Application Examples and Comparative Examples, ferrules polished by the samples of Application Examples 1~6 exhibited excellent results with an absence of polishing defects and scratches, and durability of the abrasive tape was very good, and effective work was made possible and a finished optical connector ferrule having excellent signal attenuation characteristics was made possible. On the other hand, when the above-mentioned finishing was performed for the end face of the optical connector ferrule with samples produced in the Comparative Examples, fine cracks were observed at the boundaries between the fiber and the ferrule, although polishing defects and scratches were absent. Furthermore, the durability of abrasive tapes produced in Comparative Examples was approximately 80% that of those produced in the Application Examples.

[0041] Furthermore, finishing was performed for precision parts such as semiconductor wafers, metals, ceramics, color filters for liquid crystal displays, plasma displays, optical glass, optical lenses, magnetic disk substrates, optical disk substrates, magnetic heads, and optical readout heads using each of the samples produced in the Application Examples and Comparative Examples. As a result, finishing with an absence of polishing defects and scratches resulting in excellent signal attenuation characteristics was achieved as in the case of the above-mentioned optical connector ferrule.

[Brief description of figures]

[Fig. 1] (A) The schematic diagram that shows the cracks in the polishing layer of the abrasive tape. (B) The schematic diagram that shows the cross-section view of the abrasive tape laminate.

[Fig. 2] A schematic diagram that shows the condition whereby the polishing powder is adsorbed in the cracks after use of the abrasive tape.

[Fig. 3] A schematic cross-section diagram that shows a different structure of the abrasive tape.

[Fig. 4] A schematic cross-section diagram that shows the polishing state when the abrasive tape is mounted on the pad.

[Explanation of codes]

1 Optical connector ferrule

2 Optical fiber

3 Coated part

4 Abrasive tape

5 Base film for abrasive tape

6 Primer layer

7 Polishing layer

8 Elastomer

9 Support

11 End face of optical connector ferrule

20 Abrasive

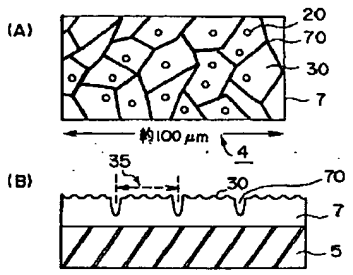
21 Abrasive powder

30 Non-cracked part

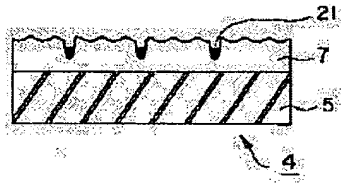
35 Pitch

70 Crack

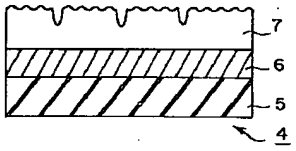
[Fig. 1]



[Fig. 2]



[Fig. 3]



[Fig. 4]